4.8 Test Reactor Area

Since the early 1950s, the Test Reactor Area (TRA), located in the south-central portion of the INL Site, has provided facilities for operation of experimental nuclear reactors, physics and chemistry laboratories, administrative space, and other plant support. There are currently 89 buildings at TRA, ranging in age from those built in the early 1950s to newly constructed buildings and structures (see Figure 4-47).

Figure 4-47. Aerial view of the Test Reactor Area.

Three major reactors have been built at TRA, including the Materials Test Reactor (MTR), which operated from 1952 to 1970; the Engineering Test Reactor (ETR), which operated from 1957 to 1982; and the Advanced Test Reactor (ATR), which began operations in 1967 and is still operational today. An additional reactor, the ATR Criticality Facility at TRA, is a full-scale, low-power version of the ATR designed to provide physics data. The MTR building (TRA-603), which housed the world's first materials test reactor, has been designated a signature property for its historic value.

The primary mission of TRA is continued operation of the ATR, the world's largest test reactor, which is used to conduct irradiated material testing, nuclear safety research, and nuclear isotope production. The ATR's current primary mission is reactor fuels and core component development and testing for the Naval Nuclear Propulsion Program. The ATR also will continue its long-term mission of radioisotope production for medical, industrial, and research applications. The ATR is planned to provide major support in the development of next-generation nuclear power systems and other advanced nuclear technologies. In addition to the ATR, several other significant nuclear operations are conducted at the TRA, which include radiochemistry laboratory operations, hot cell operations, and the Safety and Tritium Applications Research Program.

TRA was designated as WAG 2 in the FFA/CO. The main sources of contamination at TRA include the Warm Waste Pond, the Chemical Waste Pond, and the Sewage Leach Pond. Seepage from these infiltration ponds and discharge to an injection well contaminated groundwater beneath TRA, principally with chromium and tritium.

Remedial actions for TRA CERCLA sites were evaluated in the *Comprehensive Remedial Investigation/Feasibility Study for the Test Reactor Area Operable Unit 2-13 at the Idaho National Engineering and Environmental Laboratory* (hereinafter referred to as the OU 2-13 RI/FS) (DOE-ID 1997c). Fifty-five sites of known or suspected contaminant release at TRA were evaluated in the OU 2-13 RI/FS (DOE-ID 1997c). The *Final Record of Decision, Test Reactor Area, Operable Unit 2-13* (DOE-ID 1997d) determined that four sites would require remediation and that four sites would require no further action with institutional controls. The remaining 47 sites were determined to require no action. The *Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13* (DOE-ID 2000d) identified seven of the 47 sites, which were listed previously as No Action sites, requiring specific institutional controls to prevent a possible threat to human health and the environment. These seven sites along with the eight sites identified as requiring action in the *Final Record of Decision, Test Reactor Area, Operable Unit 2-13* (DOE-ID 1997d) bring the total number of sites requiring institutional controls to 15.

Two earlier RODs for TRA were the *Record of Decision: Test Reactor Area Perched Water System, Operable Unit 2-12* (DOE-ID 1992e) and the *Declaration of the Record of Decision for the Warm Waste Pond at the Test Reactor Area at the Idaho National Engineering Laboratory* (DOE-ID 1991b).

4.8.1 Current State

Current state maps of TRA are included as Figures 4-48 and 4-49. A current state conceptual site model for TRA is included as Figure 4-50.

The ETR and MTR have both been inactivated. Both facilities have been defueled, but the reactor vessels are still in place. Cleanup of the MTR canal is in progress. The ETR building is currently not being used. The MTR building is currently used for a variety of activities including office space, special projects, and warehouse facilities. Cleanup activities at the ETR and MTR buildings are scheduled to be complete by 2020.

There are still a number of open VCO actions at TRA. These are all scheduled to be complete by 2012.

The active CERCLA remediation work for OU 2-13 was completed in December 1999. Remedial actions include consolidating and capping contaminated sediments, removing contaminated materials, implementing institutional controls, and monitoring the decrease of contamination in groundwater through radioactive decay, dispersion, and natural attenuation. The *First Five-Year Review Report for the Test Reactor Area, Operable Unit 2-13, at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 2003g) found that remedies are performing as expected and are continuing to provide protection of human health and the environment. Potential short-term threats are being addressed through institutional controls. In the long term, the remedies are expected to be protective when groundwater cleanup goals are achieved through MNA.

There are currently 15 sites where institutional controls are in place because residual contamination precludes unrestricted access:

- TRA-03—Warm Waste Pond

- TRA-06—Chemical Waste Pond
- TRA-08—Cold Waste Pond
- TRA-13—Sewage Leach Pond and Berms
- TRA-13SCA—Sewage Leach Pond Soil Contamination Area
- TRA-15—Soil Surrounding Hot Waste Tanks at TRA-613
- TRA-19—Soil Surrounding Tanks 1 and 2 at TRA-630 (TRA-19)
- TRA-Y—Brass Cap Area
- TRA-04—Warm Waste Retention Basin (TRA-04)
- TRA-34—North Storage Area
- TRA-X—Hot Tree Site
- TRA-619—PCB spill site
- TRA-626—PCB spill site
- TRA-653—PCB spill site
- TRA-GW—Perched and Snake River Plain Aquifer Groundwater at TRA.

The sites are shown on Figures 4-48 and 4-49.

Active remediation was conducted at four pond sites in 1999: the Cold Waste Pond (TRA-08), the Warm Waste Pond (TRA-03), the Chemical Waste Pond (TRA-06), and Sewage Leach Pond and Berm (TRA-13).

The Cold Waste Pond (TRA-08) has been a disposal site for nonradionuclide wastewater since its construction in 1982. Wastewater disposed of in the pond includes cooling tower blowdown, air-conditioning units, floor drains, and other nonradioactive drains throughout TRA. Radionuclides have been detected at concentrations slightly above INL background levels in several samples collected from the Cold Waste Pond. These low levels of radionuclides found in the Cold Waste Pond's berms are believed to result from windblown soil contamination rather than from effluents discharged to the pond. The Cold Waste Pond is still in use today. In 1999, approximately 80 yd^3 of cesium-137-contaminated soil above 23.3 pCi/g were removed from the Cold Waste Pond and transported to the Warm Waste Pond for disposal. Institutional controls will be maintained for less than 100 years until the cesium-137 decays to levels where residential risk is below 1 in 10,000.

The Chemical Waste Pond (TRA-06) was an unlined infiltration pond designed to receive chemical waste from a demineralization plant at TRA. The pond received effluent that contained mineral salts, primarily calcium and magnesium carbonate. In addition, the pond received acid waste until 1992. In 1990, sediments collected from the pond were analyzed for metals known to be constituents of the effluent from the demineralization process. Only barium (3,830 mg/kg) and mercury (133 mg/kg) are present in the Chemical Waste Pond sediment above background levels. Sample data collected in 1998

confirmed that the Chemical Waste Pond sediment is not RCRA-characteristic hazardous waste. The pond was covered with an engineered soil cover. The soil cover was a three-layer design, consisting of a layer of gravel and coarse sand; a compacted, low-permeability layer; and a topsoil layer. The topsoil layer was reseeded with native vegetation to control erosion. Institutional controls are maintained at this site because mercury levels in soil more than 14 ft below ground present an HI of greater than 1 to the hypothetical 100-year future resident.

The Warm Waste Pond (TRA-03) encompasses an area of approximately 3.74 acres. This site received low-level radionuclides and RCRA-listed, hazardous wastewater from TRA reactor operations until 1993, when a lined evaporation pond replaced the Warm Waste Pond. In addition, radiologically contaminated material from other INL CERCLA actions was placed in the pond. The pond cells were covered with clean fill, capped with an engineered soil cover, and covered by a 2-ft-thick riprap layer to inhibit human intrusion. Data indicate that radionuclides were strongly adsorbed onto surficial sediment and that soil contamination generally did not extend more than 2 ft below the bottom of the cells. Institutional controls are required to protect occupational receptors from exposure for at least 30 years. Thereafter, institutional controls will be required for more than 100 years but less than 1,000 years until risk is less than 1 in 10,000 for residential exposure to cesium-137. The OU 2-13 RI/FS (DOE-ID 1997c) estimated that risk would decrease to less than 1 in 10,000 in approximately 270 years.

The Sewage Leach Pond, Berm, and Soil Contamination Area (TRA-13 and 13SCA) were contaminated with low-level radionuclides from windblown soil contamination originating from the Warm Waste Pond. The Sewage Leach Pond was removed from service in 1995. The Sewage Leach Pond, Berm, and Soil Contamination Area are within a fenced radiation control area, approximately 475 × 480 ft. The Sewage Leach Pond and Berm were remediated by excavating soil contaminated with cesium-137 concentrations greater than 23.3 pCi/g from the berms and placing the contaminated soil in the bottom of the Sewage Leach Pond. The area was then covered with a three-layer engineered soil cover with a minimum thickness of 10 ft, consisting of a layer of gravel and coarse sand; a compacted, low-permeability layer; and a topsoil layer. The soil contamination area (TRA-13SCA) that surrounds the Sewage Leach Pond was covered with 6 in. of clean soil. This area was designated No Further Action with institutional controls in the ROD. The topsoil layer and the soil contamination area were reseeded with native vegetation to control erosion. Institutional controls are required to protect occupational receptors from exposure for at least 30 years. In addition, the site must be restricted to industrial land use only until residential risk from cesium-137 is less than 1 in 10,000.

Limited-action sites at TRA include TRA-15, TRA-19, and TRA-Y. The subsurface soil at TRA-15 was contaminated with leakage of radiologically contaminated waste and possibly hazardous waste from an underground tank. TRA-19 consists of subsurface soil contamination that is believed to be caused by either leaks from radionuclide-contaminated drain lines or spills associated with four underground catch tanks associated with MTR.

TRA-Y is known as the Brass Cap Area, as a brass marker was placed in the concrete to designate the area of subsurface contamination. The radionuclide contamination in the soil at this site is attributed to leaking warm-waste lines. Contamination under the concrete was determined to extend to approximately 10 ft below ground. After the contamination was discovered, the leaking waste line was repaired, and contaminated soil in the immediate vicinity of the repaired waste line was removed. The excavation was backfilled with clean soil and resurfaced with concrete.

Actions taken at these sites were limited to institutional controls, with a contingent excavation and disposal option for TRA-19 and the Brass Cap Area to be used if necessary. The institutional controls include restricting occupational access and prohibiting residential use. This is accomplished through

restricted access to the INL Site, warning signs at contaminated areas, and control of activities (drilling and excavation).

Six other sites are under institutional control to restrict access until contaminant concentrations decrease to levels that allow for unlimited use and unrestricted access. TRA-04, TRA-34, and TRA-X are areas where the subsurface soil is contaminated with low levels of radionuclides. These sites exceed acceptable risk levels for current residential use; therefore, institutional controls are in place to restrict use of the sites to industrial land use only until radionuclides decay to levels acceptable for unrestricted use. The three PCB-contaminated sites (TRA-619, TRA-626, and TRA-653) were remediated in 1990 to remove PCB-contaminated soil to meet the 25-ppm limit for industrial sites defined by Toxic Substances Control Act requirements. Residual contamination at these sites is below Toxic Substances Control Act levels for industrial areas but greater than the 10-ppm requirement for unrestricted use. Therefore, permanent institutional controls will be required to prohibit future residential use.

There are three water bodies beneath TRA: (1) a shallow perched water zone about 50 ft below the surface, (2) a deep perched water zone about 150 ft below ground, and (3) the Snake River Plain Aquifer. The depth to the aquifer at TRA is approximately 450 ft. The thickness of the active portion of the aquifer is about 250 ft. The local direction of aquifer flow is to the south-southwest. Aquifer flow velocity ranges from 5 to 20 ft/day. The aquifer is locally recharged by the Big Lost River and by clean water that enters the subsurface at the rate of approximately 300 gal/hour from one disposal pond still in use.

The selected remedy for TRA groundwater was No Action with Monitoring. The *Post Record of Decision Monitoring Plan for the Test Reactor Area Perched Water System Operable Unit 2-12* (Dames & Moore 1993) specified that sampling and analysis for all COCs would be performed quarterly for six deep perched water wells and semiannually for four aquifer wells.

The primary COCs identified for the aquifer are chromium and tritium. Tritium levels in all aquifer wells are below the MCL and are expected to continue to decrease because of radioactive decay and dilution. Measured concentrations of chromium levels currently exceed the MCL (100 μg/L) in two wells. The unfiltered chromium levels are approximately 160 μg/L in TRA-07 and approximately 130 μg/L in USGS-065. The chromium levels have been decreasing since 1990 and are expected to decline below the MCL by 2012 for all wells. This projection is supported by groundwater data collected and summarized in the *First Five-Year Review Report for the Test Reactor Area, Operable Unit 2-13, at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 2003g).

Groundwater modeling completed before signing of the OU 2-12 ROD (DOE-ID 1992e) predicted the dissipation of perched water within 7 years following cessation of discharge to all disposal ponds. The new mission for the INL, which will keep TRA operational for at least another 20 years, will cause perched water to persist beneath TRA beyond the modeling assumptions used in the risk assessment. The primary source of water to the perched water system, the Cold Waste Pond, receives only uncontaminated effluent. There has been a general decreasing trend in concentrations for chromium, tritium, strontium-90, and cobalt-60 in the perched water zone. Exceptions to the general decreasing trend include increasing or flat activities of strontium-90 in four perched water wells and a recent increase of cobalt -60 in one well. Because of the high Kd (i.e., soil-water partitioning coefficient) values of these contaminants, the short half-lives, and the fact that pre-ROD modeling used similar concentrations in perched water to model impact to the aquifer, it seems unlikely that the downward transport of perched water containing strontium -90 or cobalt-60 could significantly impact the aquifer. Diesel was discovered during drilling of one well during the remedial investigation in 1990. Product floating on the deep perched water body has been observed in this well intermittently since that time, and it has been the subject of several investigations. The results of the modeling determined that the diesel did not pose an unacceptable risk to the aquifer. However, the source and aerial extent of the diesel plume have never been fully characterized,

and it was determined during the first 5-year review that additional characterization of this problem is warranted. Ongoing discussions with the agencies will define activities to fully evaluate the perched water contamination and long-term impacts on the aquifer given that TRA operations are expected to continue for at least another 20 years.

Additional information on contaminant concentrations and risk levels for the 15 sites that are currently under institutional control is provided in Table 4-10. Additional detailed information on current state conditions at TRA is available from the *First Five-Year Review Report for the Test Reactor Area, Operable Unit 2-13, at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 2003g).

4.8.2 End State

Maps showing TRA at the 2035 end state are provided as Figures 4-51 and 4-52. It is anticipated that institutional controls at the following sites will be discontinued within 30 years:

- TRA-04 (the Warm Waste Retention Basin surficial sediments)
- TRA-08 (the Cold Waste Disposal Pond)
- TRA-34 (soil at North Storage Area)
- TRA-X (soil contamination at Hot Tree Site).

The Sewage Leach Pond (TRA-13) will require controls through approximately 500 years. TRA-03 (the Warm Waste Pond) will require controls for at least 100 years but less than 1,000 years because of cesium-137 contamination. Institutional controls at these sites include warning signs and control of activities (drilling or excavating). Long-term institutional controls to prevent intrusion will be required at TRA-06, the Chemical Waste Pond, because of mercury contamination 14 ft below ground. Institutional controls at TRA-15, TRA-19, TRA-Y, TRA-13SCA, and the three PCB contaminated sites still will be required in 2035 at completion of the EM cleanup mission. TRA-13SCA and TRA-15 are expected to be available for unrestricted industrial use at that time, but controls still will be needed to prohibit residential use.

A conceptual site model for TRA at the end state is provided as Figure 4-53.

NE is now designated the LPSO and has assumed ownership of most of the buildings at TRA. NE will determine which of the buildings will be needed for future missions. At the present time, it is expected that 34 excess facilities will be demolished and removed before 2035. The MTR has been designated a signature property for its historic significance. The ultimate disposition of this building has not yet been determined, but it is possible it may be preserved for its historic value. Both the ETR and the MTR have been identified as high-risk facilities because of high levels of radioactive contamination. The two buildings have not yet been fully characterized, so the end state for these buildings has not yet been determined. However, it may not be possible to remove all of the radioactive materials from these facilities because of risk of unacceptable radiation exposure to workers. As a result, ETR has been shown on Figures 4-51 and 4-52 as a grouted and capped facility, while MTR is shown as a historic signature property.

4.8.3 Risk Assessment Summary

Detailed risk assessment information for TRA CERCLA sites is published in the OU 2-13 RI/FS (DOE-ID 1997c). The OU 2-13 baseline risk assessment in the OU 2-13 RI/FS (DOE-ID 1997c) contains

both a human health and an ecological risk evaluation. Each of these evaluations is summarized in the following sections. Remedial actions were selected so as to be protective of current and future workers and future (100-year) residents. No remedial actions were identified on the basis of ecological risk alone.

4.8.3.1 Human Health Risk Evaluation. The OU 2-13 baseline risk assessment in the OU 2-13 RI/FS (DOE-ID 1997c) included an evaluation of human health risks associated with exposure to contaminants through soil ingestion, fugitive dust inhalation, volatile inhalation, external radiation exposure, groundwater ingestion, ingestion of homegrown produce, dermal adsorption of contaminants in groundwater, and inhalation of water vapors because of indoor water use. The residential scenarios modeled a person living on the site 350 days a year for 30 years, beginning in 2097 (100 years from 1997) and 2997 (1,000 years from 1997). The 100-year residential scenario was selected for analysis because the INL institutional control is expected to last for at least 100 years. The 1,000-year residential scenario was evaluated because 1,000 years is a sufficient period of time to allow for decay of the short half-life radionuclides at WAG 2. For purposes of the baseline risk assessment, it was assumed that future residents will construct 10-ft basements beneath their homes, so they could be exposed to contaminants down to that depth.

The occupational scenarios modeled nonintrusive daily industrial use without restrictions. The two occupational scenarios that were analyzed include a current occupational scenario that lasts for 25 years from the present and a future occupational scenario that starts in 30 years and lasts for 25 years.

Additional information on assumptions, exposure scenarios, uncertainties, and conclusions is available in the OU 2-13 RI/FS (DOE-ID 1997c).

4.8.3.2 Ecological Risk Assessment. Wildlife species present in and around the TRA include birds, mammals, and reptiles that are associated with facilities, sagebrush-steppe, rock outcroppings, deciduous trees and shrubs, grasslands, and water (e.g., facility ponds and drainage areas). Both aquatic and terrestrial species are potentially present. Sagebrush-steppe habitat supports a number of species including sage grouse, pronghorn, elk, and waterfowl (all important game species). Grasslands provide habitat for species such as the western meadowlark and mule deer, also a game species. Rock outcroppings support species such as bats, woodrats, and sensitive species such as the pygmy rabbit. Buildings, lawns, and ornamental vegetation and ponds at TRA are used by a number of species such as waterfowl, raptors, rabbits, mule deer, and bats. No areas of critical habitat are known to exist in or around TRA.

Flora surrounding TRA were characterized using a vegetation map constructed for the INL using LANDSAT imagery and field measurements from vegetation plots. Sagebrush-steppe on lava and sagebrush-rabbitbrush are the most common vegetation types. Fauna potentially existing in the TRA area were identified by updating 1986 data on relative abundance, habitat use, and seasonal presence of amphibians, reptiles, birds, and mammals, recorded on the INL and communicating with researchers and personnel conducting ecological studies since 1986. Species potentially present at and surrounding WAG 2 represent all 22 INL avian functional groups and nine of 10 mammalian functional groups. Both reptilian functional groups are present. No amphibians are known to be present, and no surface hydrology exists to support fish. Aquatic invertebrates, however, are supported by habitat provided by facility treatment ponds.

No threatened or endangered plant species have been recorded in the TRA area. Four mammalian species of concern potentially occur at or near TRA. These include the pygmy rabbit, Townsend's western big-eared bat, the long-eared myotis, and the small-footed myotis. Although the presence of the pygmy rabbit at or near TRA has not been verified, appropriate habitat exists in the northern and eastern sections where basalt flows are present. Townsend's western big-eared bat, the small-footed myotis, and

the long-eared myotis are not known to frequent TRA, and no caves are known to exist in the immediate area. However, surface water in the TRA Cold Waste Pond and facility lighting may attract bats in general. The sagebrush lizard is the only reptile species of concern with a potential presence at TRA.

Avian threatened or endangered species or species of concern with a potential for occurrence in the vicinity of TRA include the ferruginous hawk, peregrine falcon, northern goshawk, loggerhead shrike, burrowing owl, bald eagle, white-faced ibis, black tern, and trumpeter swan. The bald eagle is a federally listed threatened or endangered species. A geographic information system analysis showed that no threatened or endangered raptor nest sites are known at TRA. Both ferruginous hawks and loggerhead srikes are commonly observed in areas surrounding TRA.

Contaminated surface soil represents the major source of possible contaminant exposure for WAG 2 ecological components. Surface soil includes the uppermost 0.5 ft. Ecological receptors can be exposed to contaminated media directly through ingestion of contaminated vegetation, water, and prey; incidental ingestion of soil; or physical contact or inhalation. Inhalation and physical contact, however, are considered to play minor roles in the exposure to surface contamination for WAG 2.

Contaminants in subsurface soil can be transported to ecological receptors by plant uptake and translocation by burrowing animals. Once contaminated soil is brought close to the surface, transport and exposure scenarios for ecological receptors are the same as for surface soil. For subsurface contamination, inhalation and direct contact by burrowing animals are more important exposure routes than for surface contamination. Receptors having potential for direct exposure to WAG 2 subsurface soil contamination include animals dwelling below ground and deep-rooting plants. Contamination at depths greater than 10 ft is considered inaccessible to ecological receptors because that depth generally is below the root zone of plants and the burrowing depth of ground-dwelling animals.

The Cold Waste Pond still contains water and represents a potential for receptor exposure to contaminants from ingestion of sediment, forage, and surface water.

Eleven sites were found to pose potential risk to ecological receptors (TRA-02, TRA-03, TRA-04/05, TRA-06, TRA-08, TRA-13, TRA-15, TRA-16, TRA-19, TRA-38, and the Brass Cap Area). These sites all had ecological HQs greater than 1. Four of these sites are outside of the TRA facility fence: TRA-03, TRA-06, TRA-08, and TRA-13. Human health risks exceeding acceptable levels exist at these four sites. It was concluded that the selected remedial alternative to reduce human health risks at these sites also would reduce ecological risks. The remaining sites are within the facility fence, where ongoing facility operations and absence of habitat will minimize the exposure of ecological receptors. The relatively small size of the sites also contributes to little or no ecological risk.

Table 4-10. Contaminant concentrations and risk levels for sites under institutional control at the Test Reactor Area.

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 Years	Basis for ICs and Comments
TRA-03 (Warm Waste Pond)	Cesium-137	N/A	2.9–39,400 pCi/g below 10 ft clean fill and engineered cap	2 in 100 (external radiation exposure)	1 in 100 (external radiation exposure)	9 in 1,000 (external radiation exposure)	No[a]	Remediation complete (containment).	Yes	The site contains radiologically contaminated soil below an engineered cover. Total risk for the residential scenario is projected to diminish to 1 in 10,000 in 100–1,000 years.
	Silver-108m	N/A	0.2–27,100 pCi/g below 10 ft clean fill and engineered cap	3 in 100,000	2 in 100,000	7 in 100,000	No[a]	Remediation complete (containment).		ICs are in place to prevent intrusion.
	Europium-152	N/A	Below 10 ft clean fill and engineered cap	2 in 1,000	5 in 10,000	6 in 100,000	No[a]	Remediation complete (containment).		ICs are in place to prevent intrusion.
TRA-04 (Warm Waste Retention Area)	Cobalt-60	N/A	<1,320 pCi/g	No	No	No	No	No Action site.	No	Current residential risk is 5 in 10,000 for 10 ft and less. Restrict site to industrial use only for <10 ft deep. Restrict land use for deeper contamination until evaluated otherwise. (Risk not evaluated for suspected contamination at depth of 40 ft.)

Table 4-10. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 Years	Basis for ICs and Comments
	Cesium-137	N/A	<9,150 pCi/g	No	No	No	No	No Action site.		Current residential risk is 5 in 10,000 for 10 ft and less. Restrict site to industrial use only for <10 ft deep. Restrict land use for deeper contamination until evaluated otherwise. (Risk not evaluated for suspected contamination at depth of 40 ft.)
	Acrylonitrile	N/A	<0.0471 mg/kg	No	No	No	>10 and <100	No Action site.		Current residential risk is 5 in 10,000 for 10 ft and less. Restrict site to industrial use only for <10 ft deep. Restrict land use for deeper contamination until evaluated otherwise. (Risk not evaluated for suspected contamination at depth of 40 ft.)
	Lead	N/A	<39.7 mg/kg	No	No	No	>10 and <100	No Action site.		Current residential risk is 5 in 10,000 for 10 ft and less. Restrict site to industrial use only for <10 ft deep. Restrict land use for deeper contamination until evaluated otherwise. (Risk not evaluated for suspected contamination at depth of 40 ft.)

Table 4-10. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 Years	Basis for ICs and Comments
TRA-06 (Chemical Waste Pond)	Mercury	N/A	≤133 mg/kg	No	No	(HI >1 for mercury through produce and soil ingestion at a depth of 14 ft)	No[a]	Remediation complete (containment).	Yes	The site has mercury 14 ft below grade. A native soil cover was placed over the site. The HI is >1 for the residential scenario at 14 ft below grade and is not expected to diminish.
	Barium	N/A	≤3,830 mg/kg	No	No	No	No[a]	Remediation complete (containment).		ICs include soil cover integrity monitoring and maintenance, surface water diversions, access restrictions, and long-term environmental monitoring. Environmental monitoring and ICs will be maintained for at least 100 years.
TRA-08 (Cold Waste Pond)	Cesium-137	23.3 pCi/g	23.7 pCi/g	1 in 10,000	7 in 100,000	7 in 100,000	No	Remediation complete (excavation and disposal).	No	Pond is still in use. Need to restrict site to industrial land use for less than 100 years until residential risk is <1 in 10,000 based on the results of a 5-year review.
TRA-13 (Sewage Leach Pond)	Mercury	N/A	<4.7 mg/kg under 10 ft native soil cover	Not available	Not available	HI >1 (for ingestion of homegrown produce)	No	Remediation complete (containment).	Yes	ICs required to prevent residential use.
	Zinc	N/A	<795 mg/kg under 10 ft native soil cover	Not available	Not available	HI >1 (for ingestion of homegrown produce)	No	Remediation complete (containment).		ICs required to prevent residential use.

Table 4-10. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 Years	Basis for ICs and Comments
	Cesium-137 and silver-108m	N/A	<136 pCi/g under 10 ft native soil cover	1 in 1,000	4 in 10,000	5 in 10,000 (at depth of 14 ft)	No	Remediation complete (containment).		The site contains radiologically contaminated soil beneath a native soil cover. Total for the residential scenario is projected to diminish to 1 in 10,000 in about 500 years. Restrict site for occupational access for >30 years and then restrict to industrial land use only until residential risk is <1 in 10,000.
TRA-13SCA (Sewage Leach Pond Berm and Soil Contamination Area)	Cesium-137	23.3 pCi/g	<39 pCi/g under 10 ft native soil cover	2 in 10,000	8 in 100,000	9 in 100,000	No	No Further Action (Limited Action).	No	Restrict occupational and residential access until risk is <1 in 10,000 based on a 5-year review. Residential risk is expected to diminish to <1 in 10,000 in about 100 years.
TRA-15 (Soil at Hot Waste Tanks)	Cesium-137	23.3 pCi/g	Cesium-137 <2,000 pCi/g, strontium-90 <2,280 pCi/g, and lead <225 mg/kg (at depths below 13 ft)	3 in 10,000 (external radiation exposure)	2 in 10,000 (external radiation exposure)	1 in 10,000 (external radiation exposure)	No[a]	Limited Action. Tanks still in use.	Yes	Contaminated soil from 13 to 37 ft below ground. ICs needed to prevent access to deeper soil. Restrict occupational and residential access for <100 years until risk is <1 in 10,000. After this restriction is removed, restrict land use at depths greater than 10 ft. until otherwise evaluated.

Table 4-10. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 Years	Basis for ICs and Comments
TRA-19 (Soil around tanks and Brass Cap Area)	Cesium-137	23.3 pCi/g	Not available	2 in 10 (external radiation exposure)	8 in 100 (external radiation exposure)	8 in 100 (external radiation exposure)	No	Limited Action with contingent excavation and disposal. New tanks still in use.	Yes	Restrict occupational access and prohibit residential development until soil is removed or status is changed based on a 5-year review.
TRA-34	Silver-108m, cesium-137, and europium-152	N/A	15 pCi/g (cesium-137)	No	No	3.5 in 100,000	No	No Action site.	No	Restrict land use to industrial land use only for 30 years until residential risk is <1 in 10,000 based on a 5-year review. (Current residential risk is 1.2 in 10,000.)
TRA-619 (PCB Spill)	PCB	25 mg/kg	≤22 mg/kg	No	No	Yes	No	Remediation complete.	Yes	Concentration is higher than 10 mg/kg allowed for unrestricted use (40 CFR 761.125). Permanently restrict this site to industrial land use only, unless otherwise indicated in a 5-year review.
TRA-626 (PCB Spill)	PCB	25 mg/kg	≤24 mg/kg in soil and >4 ft deep	No	No	Yes	No	Remediation complete.	Yes	Concentration is higher than 10 mg/kg allowed for unrestricted use (40 CFR 761.125). Permanently restrict this site to industrial land use only, unless otherwise indicated in a 5-year review.

Table 4-10. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 Years	Basis for ICs and Comments
TRA-653 (PCB Spill)	PCB	25 mg/kg	<25 mg/kg	No	No	Yes	No	Remediation complete.	Yes	Concentration is higher than 10 mg/kg allowed for unrestricted use (40 CFR 761.125). Permanently restrict this site to industrial land use only, unless otherwise indicated in a 5-year review.
TRA-X (Hot Tree Site)	Cesium-137	N/A	4.8 pCi/g	No	No	2 in 100,000	No	No Action site.	No	Current residential risk is 2 in 10,000. Restrict site to industrial land use only for 30 years until residential risk is <1 in 10,000 based on results of a 5-year review.
TRA-Y (Brass Cap Area)	Cesium-137	23.3 pCi/g	6,060 pCi/g	3 in 10	8 in 100	8 in 100	>1 and <10	Limited Action with contingent excavation and disposal.	Yes	Restrict occupational access and prohibit residential development until contamination removed or status changed based on a 5-year review.

Sources of Information:

Final Record of Decision, Test Reactor Area, Operable Unit 2-13 (DOE-ID 1997d)

Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13 (DOE-ID 2000d)

Explanation of Significant Differences for the Record of Decision for the Test Area North Operable Unit 1-10 (DOE-ID 2003b)

Comprehensive Remedial Investigation/Feasibility Study for the Test Reactor Area Operable Unit 2-13 at the Idaho National Engineering and Environmental Laboratory (DOE-ID 1997b)

a. Contamination is >10 ft below ground, so there is no pathway to ecological receptors.

Note: Remediation goals for radionuclides were based on risk to the hypothetical 100-year resident.

Note: Remediation goals for PCBs were based on U.S. Environmental Protection Agency industrial standards.

HI = hazard index
IC = institutional control
N/A = not applicable
PCB = polychlorinated biphenyl

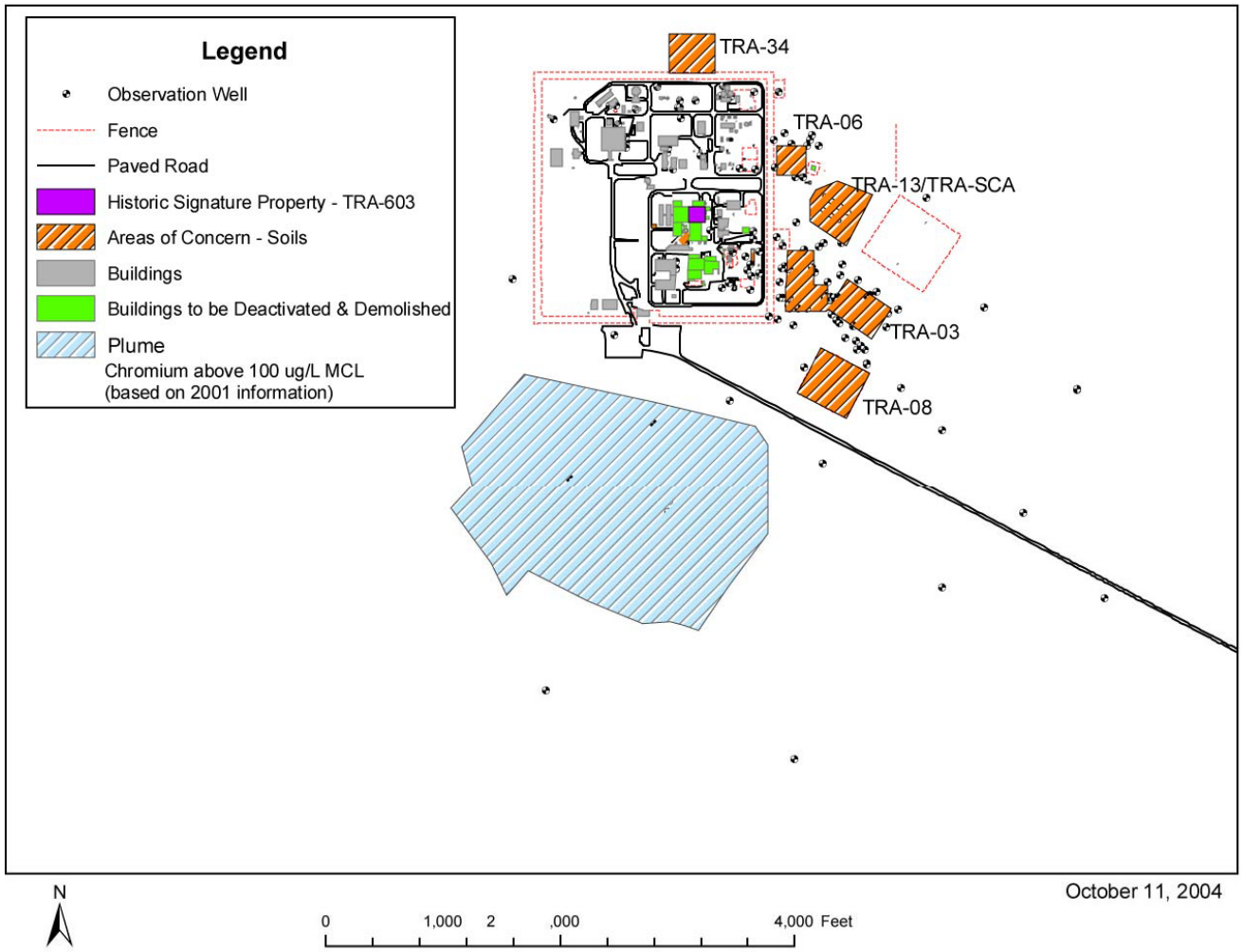


Figure 4-48. Test Reactor Area map—current state.

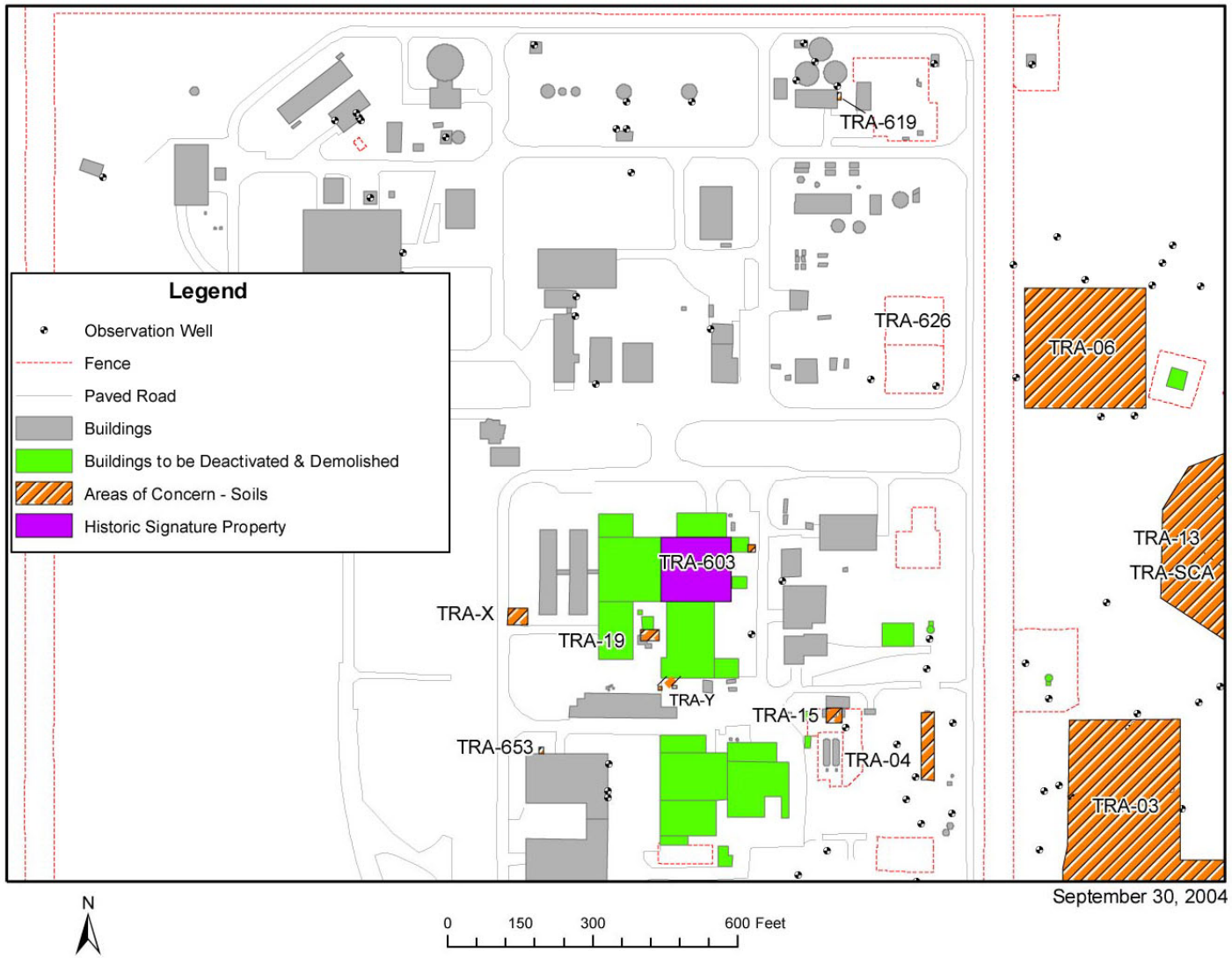
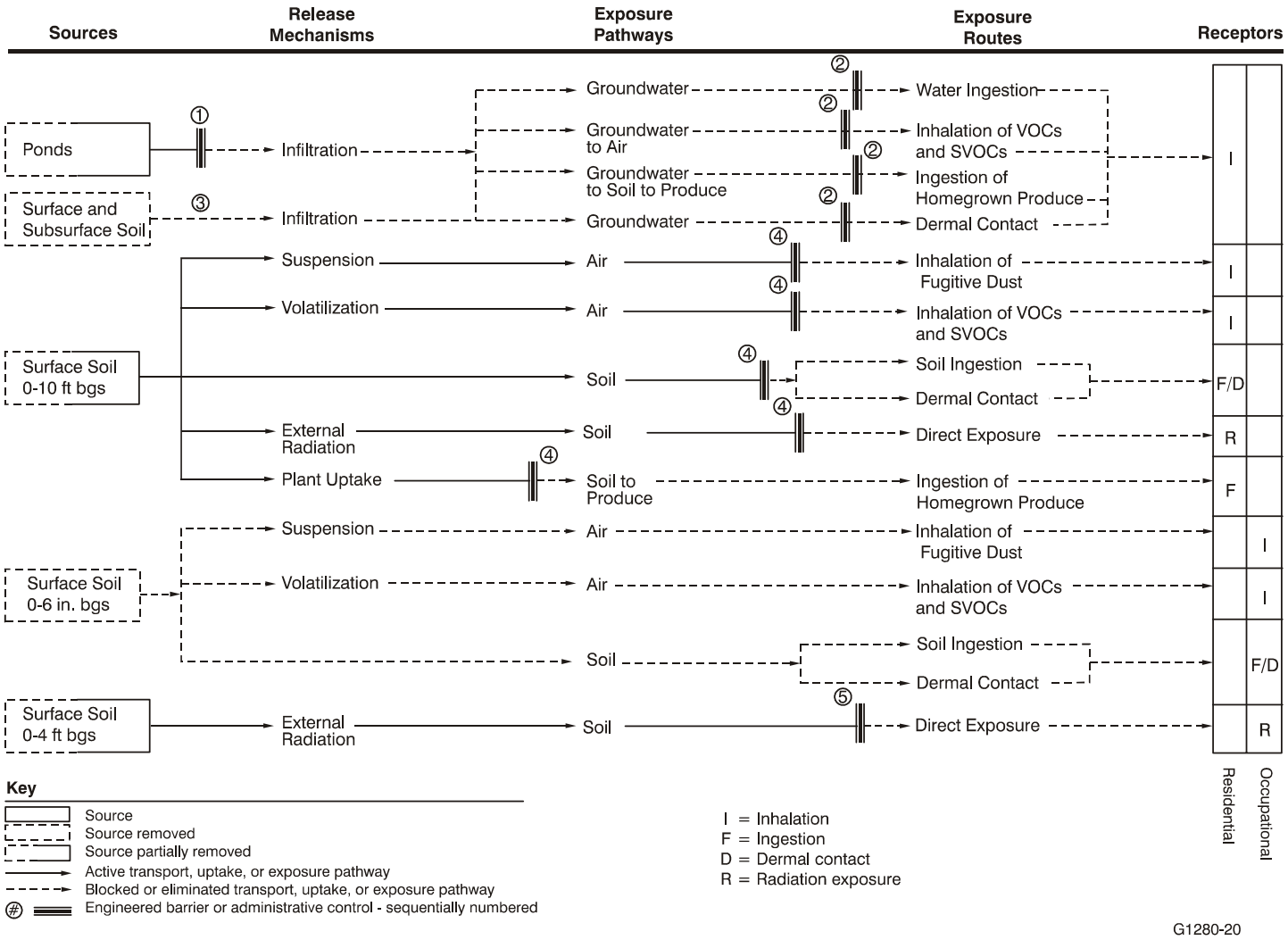


Figure 4-49. Test Reactor Area facility detail map—current state.



SVOC = semivolatile organic compound

Figure 4-50. Test Reactor Area conceptual site model—current state.

Narrative for Figure 4-50 Test Reactor Area Conceptual Site Model—Current State

All active remedial actions required by the OU 2-13 ROD (DOE-ID 1997d) have been completed. During the first 5-year remedy effectiveness review for OU 2-13 conducted in 2003, it was found that the remedies are performing as expected and are continuing to provide protection of human health and the environment (DOE-ID 2003e).

Institutional controls are in place because residual contamination precludes unrestricted access in the following 15 areas:

- Three out-of-service, covered pond sites (TRA-03 Warm Waste Pond, TRA-06 Chemical Waste Pond, and TRA-13 Sewage Leach Pond) and one operating pond, the TRA-08 Cold Waste Pond
- Three sites with PCB contamination that have been cleaned up to meet Toxic Substances Control Act requirements
- Seven sites with residual radionuclide contamination in subsurface soil (i.e., TRA-13SCA, TRA-15, TRA-19, TRA-Y, TRA-04, TRA-34, and TRA-X)
- Contamination in perched water zones and the Snake River Plain Aquifer (TRA-GW).

Actions and Barriers:

The steps taken to mitigate or remove these hazards are as follows:

1. The selected remedy for the Warm Waste Pond (TRA-03) was containment by capping. This pond was capped with an engineered soil cover with a 2-ft-thick layer of riprap. Before capping, this site was used as a disposal facility for contaminated soil from other parts of the INL. The Chemical Waste Pond (TRA-06) was capped with an engineered soil cover and revegetated. Mercury contamination that has an HI greater than 1 for residential ingestion of homegrown produce and soil ingestion is present at depths below 14 ft and is not expected to diminish over time. The Sewage Leach Pond and Berm (TRA-13) were remediated by removing soil contaminated with cesium-137 at concentrations greater than 23.3 pCi/g from the berms, placing the contaminated soil in the pond basin, and covering the pond with a 10-ft-thick engineered soil cover.

   Only one of the ponds still contains water: the Cold Waste Pond. The Cold Waste Pond was remediated by removing soil contaminated with cesium-137 from the basin and disposing of the contaminated soil in the Warm Waste Pond. This pond is still in use for disposal of uncontaminated wastewater only. Existing contamination in the groundwater is being remediated through MNA, radioactive decay, and dispersion.

2. Long-term institutional controls are in place for all four ponds. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, and through the work control process used to identify hazards and mitigation measures for planned work activities. Potable water wells used to supply water to workers at the INL are routinely monitored for groundwater quality.

3. All surface and subsurface soil with potential to impact the groundwater has been removed.

4. Areas with residual soil contamination that still present unacceptable risk to hypothetical residential receptors include three sites with PCB contamination (TRA-619, TRA-626 and TRA-653). The residual PCB contamination at these sites is below the 25-ppm action level defined by Toxic Substances Control Act requirements but above the 10-ppm cleanup level that would be required for residential use of the sites. Permanent institutional controls to prevent residential use of these sites are required.

   There are also a number of sites with residual radionuclide levels. TRA-15, TRA-19, TRA-Y, TRA-04, TRA-34, and TRA-X all currently require institutional controls to protect potential future residential receptors. Institutional controls consist of restricted access to prevent intrusion by the public and warning signs.

5. Areas with residual soil contamination that require institutional controls to protect occupational receptors include TRA-15, TRA-19, and the soil contamination area in the vicinity of the Sewage Leach Pond (TRA-13SCA). The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, through radiological control training, and through the work control process used to identify hazards and mitigation measures for planned work activities.

Failure Analysis:

The Warm Waste Pond (TRA-03), the Chemical Waste Pond (TRA-06), and the Sewage Leach Pond (TRA-13) were all remediated by containment. Engineered and native soil covers were designed to prevent direct radiation exposure, resist erosion caused by wind and surface water run-off, and resist biointrusion that may penetrate the contamination zone.

The long-term performance of engineered covers is considered to be highly effective for preventing external exposure to contaminated surface soil. The engineered covers are designed to maintain their effectiveness for hundreds of years with minimal maintenance requirements. Although the engineered cover is designed to be maintenance free, cap integrity monitoring as well as periodic removal of undesirable vegetation and burrowing animals (if necessary) are performed during the period of institutional control.

Erosion and human intrusion are the most likely causes of barrier failure, resulting in the external exposure to contaminated surface and subsurface soil. The physical size of the engineered cover and the coarse texture of component layers specified in the design are considered effective for erosion resistance. Inadvertent human intrusion is discouraged by the thickness (approximately 10–12 ft) of the covers. Human intrusion through a basalt riprap layer would be difficult.

The potential for vegetative intrusion into the contaminated soil could result in long-term maintenance requirements. Deep-rooting plants or burrowing invertebrates could mobilize radionuclides in the environment.

Measures used to monitor covers at the TRA sites are documented in the *Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Test Reactor Area, Operable Unit 2-13* (DOE-ID 2000e). The engineered cover for the Warm Waste Pond is inspected for subsidence and erosion, animal intrusion, effectiveness of surface water run-off, and institutional controls. The native soil covers for the Sewage Leach Pond and the Chemical Waste Pond are inspected annually for vegetative cover, invasion of weeds, and erosion. In addition, annual radiation surveys are conducted for the Warm Waste Pond and the Sewage Leach Pond to locate and document areas of high-gamma

activity. Minor problems that are identified will be resolved and documented in an annual operations and maintenance report, which is submitted to EPA and DEQ.

These activities are conducted annually. The frequency of inspections will be evaluated during future 5-year reviews. Should a cover fail, the DOE Idaho will determine the nature and extent of repairs with concurrence from DEQ and EPA.

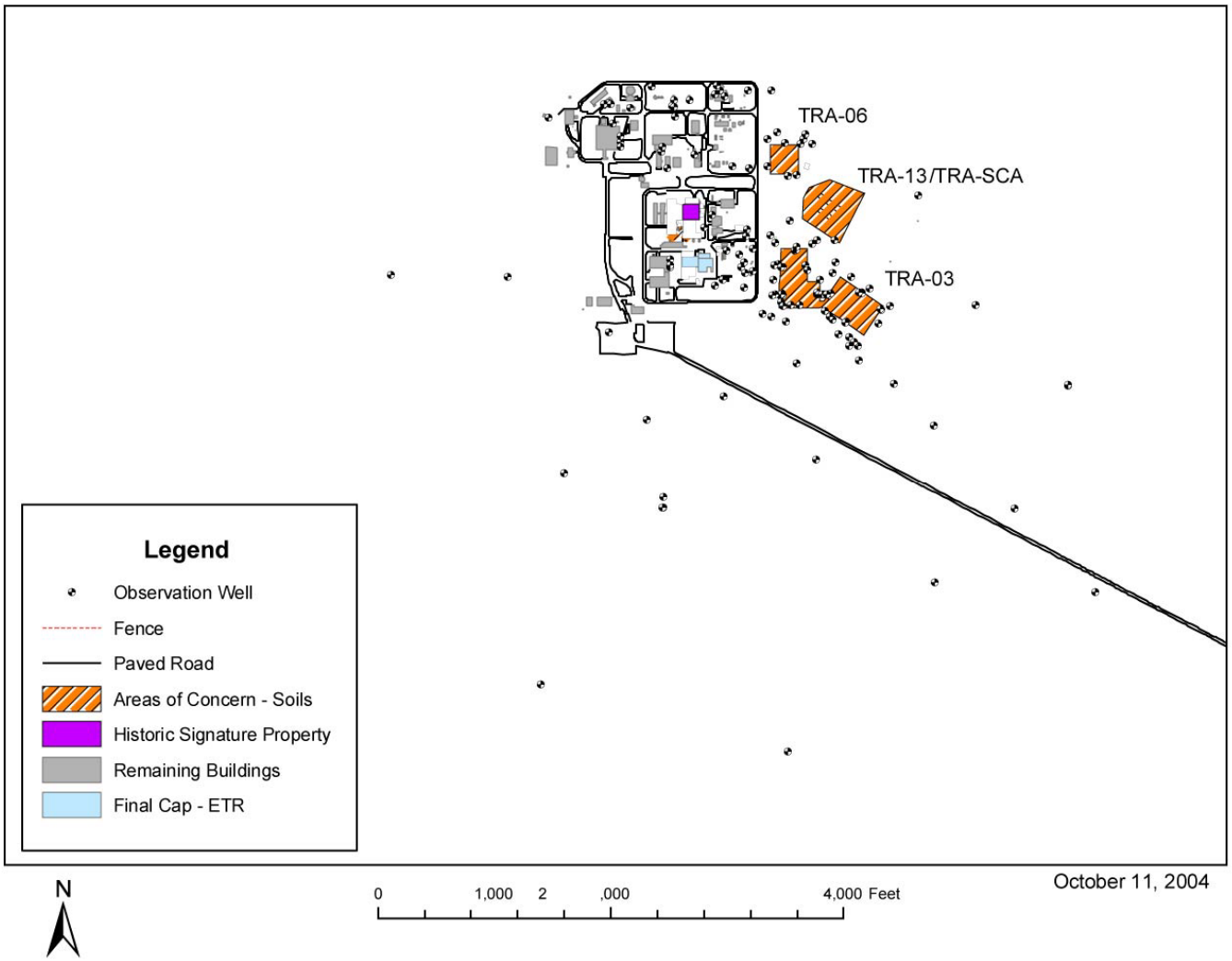


Figure 4-51. Test Reactor Area map—end state.

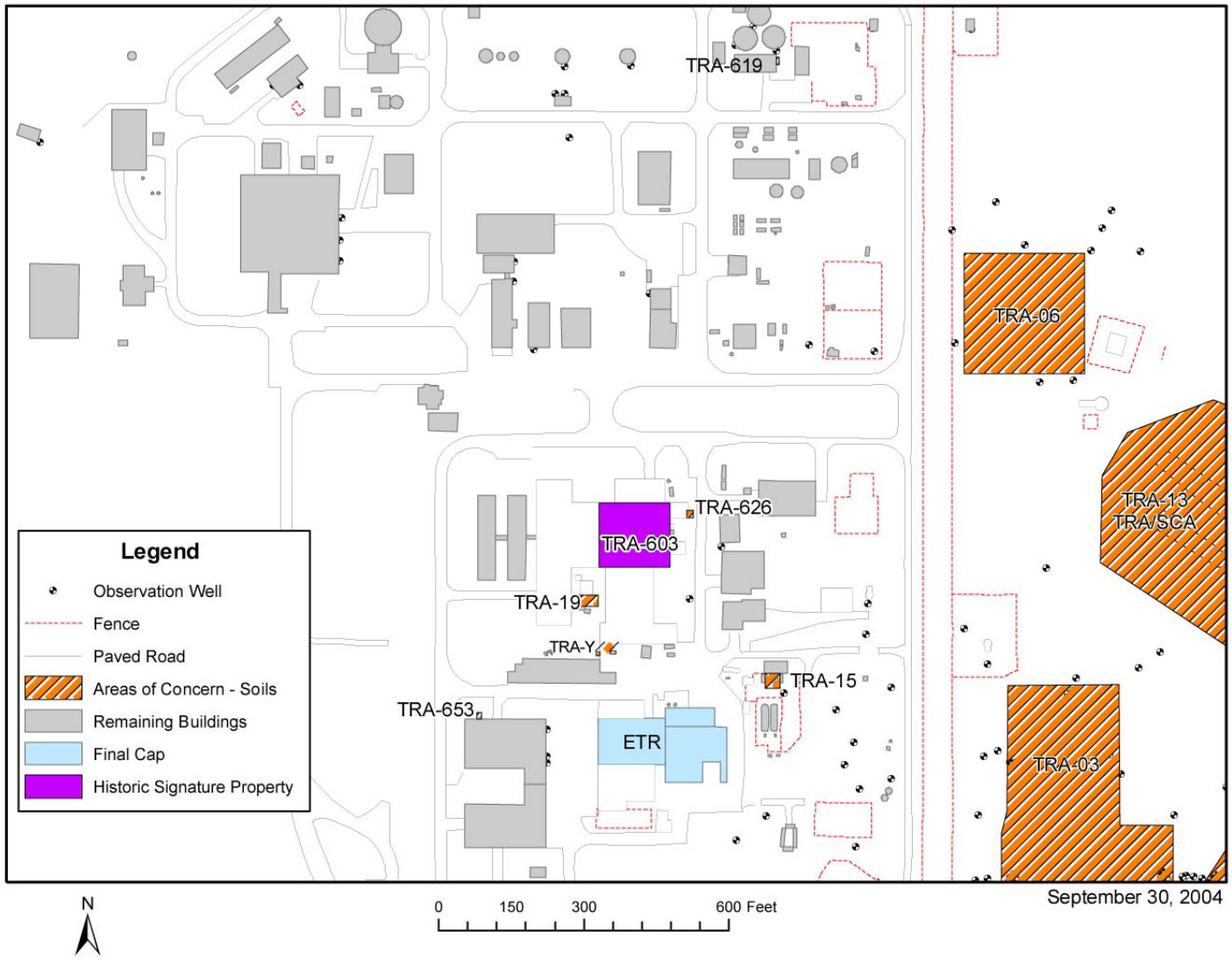
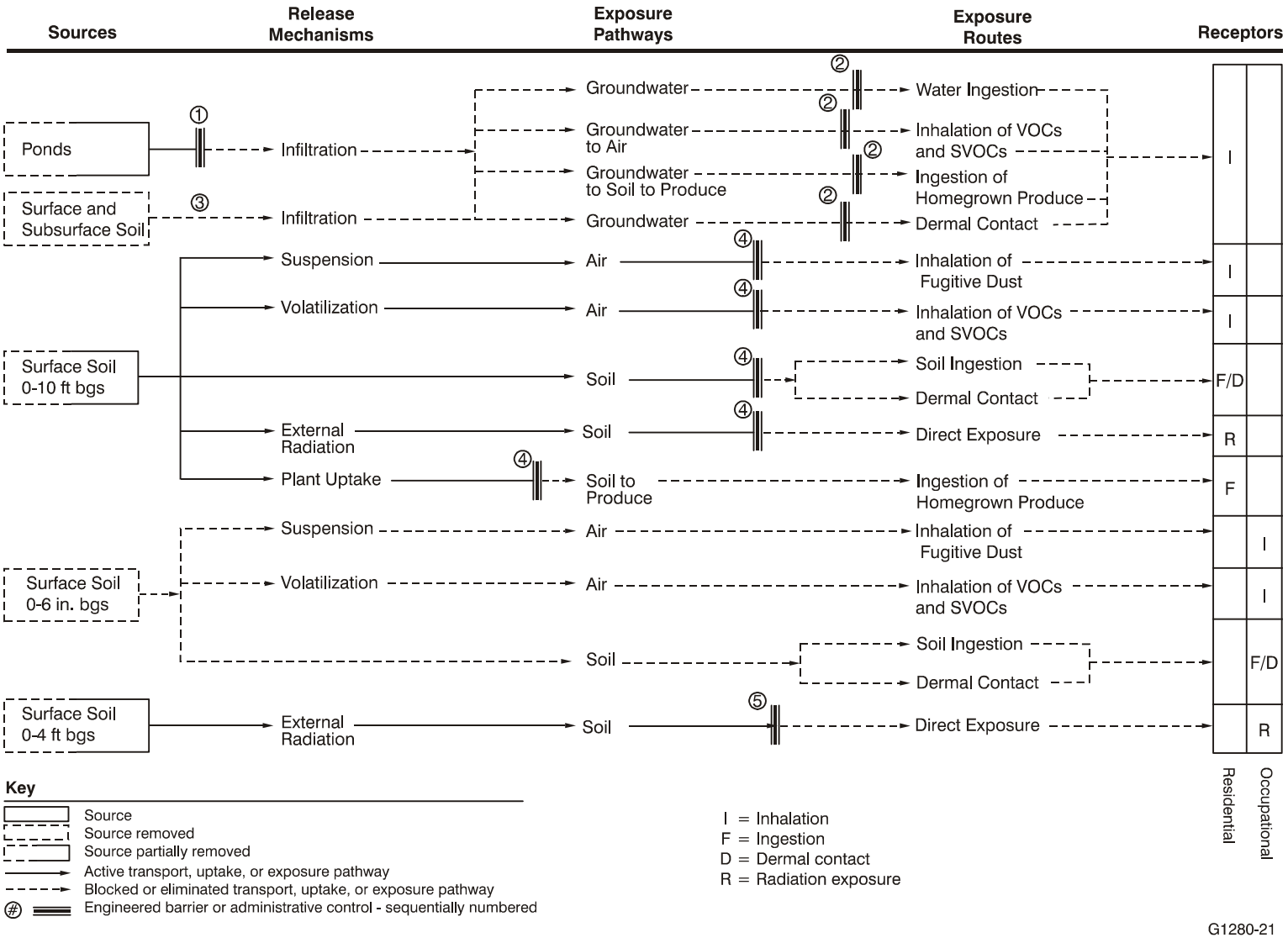


Figure 4-52. Test Reactor Area facility detail map—end state.



SVOC = semivolatile organic compound

Figure 4-53. Test Reactor Area conceptual site model—end state.

Narrative for Figure 4-53 Test Reactor Area Conceptual Site Model—End State

Chromium concentrations in the groundwater will be below MCLs before 2035. It is anticipated that the following sites still will require institutional controls because of residual contamination:

- Two out-of-service, covered pond sites, TRA-03 Warm Waste Pond and TRA-13 Sewage Leach Pond, will require institutional controls for 100 years and 500 years, respectively, because of residual radionuclides.
- Three sites with PCB contamination that have been cleaned up to meet Toxic Substances Control Act requirements will require permanent institutional controls to preclude residential use. (Industrial use is unrestricted.)
- Four sites with residual radionuclide contamination in subsurface soil include TRA-13SCA, TRA-15, TRA-19, and TRA-Y.

Actions and Barriers:

The steps taken to mitigate or remove these hazards are as follows:

1. The Warm Waste Pond (TRA-03) was capped with an engineered soil cover with a 2-ft-thick layer of riprap. Before capping, this site was used as a disposal facility for contaminated soil from other parts of the INL. The Sewage Leach Pond and Berm (TRA-13) were remediated by removing soil contaminated with cesium-137 at concentrations greater than 23.3 pCi/g from the berms, placing the contaminated soil in the pond basin, and covering the pond with a 10-ft-thick engineered soil cover.
2. Long-term institutional controls will need to be maintained at TRA-03 and TRA-13 to protect hypothetical residential receptors. As long as there is an active DOE mission, the entire INL Site will continue to have restricted access to prevent intrusion by the public. If the DOE mission should end at some future point, property transfer requirements with deed restrictions would be required.
3. All surface and subsurface soil with potential to impact the groundwater has been removed.
4. Areas with residual soil contamination that will still present unacceptable risk to hypothetical residential receptors at the end state include three sites with PCB contamination (TRA-619, TRA-626, and TRA-653). The residual PCB contamination at these sites is below the 25-ppm action level defined by Toxic Substances Control Act requirements but above the 10-ppm cleanup level that would be required for residential use of the sites. Permanent institutional controls to prevent residential use of these sites will be required.

   It is expected that TRA-13SCA, TRA-15, TRA-19, and TRA-Y will still require institutional controls to protect potential residential receptors. (Continued need for institutional controls is evaluated through the 5-year reviews.) Institutional controls consist of restricted access to prevent intrusion by the public and warning signs. In the event that the DOE mission should end at some unknown time in the future, deed restrictions would be required to prevent intrusion into those areas with residual contamination.
5. Areas with residual soil contamination that will probably still require institutional controls to protect occupational receptors will include TRA-19 and TRA-Y. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database,

through radiological control training, and through the work control process used to identify hazards and mitigation measures for planned work activities. In the event that the DOE mission should end at some unknown time in the future, deed restrictions would be required to prevent intrusion into those areas with residual contamination.

Failure Analysis:

The engineered and native soil covers for TRA-03, TRA-06, and TRA-13 have been designed to provide long-term protectiveness. However, risks to human health will still remain after the end of the EM mission. As a result, long-term stewardship requirements for the covers will be identified before the end of the EM mission.

4.9 Argonne National Laboratory-West

Argonne National Laboratory-West (ANL-W) was established in the 1950s by the Atomic Energy Commission to support advanced nuclear reactor and nuclear fuel design and testing. ANL-W is located approximately 32 miles west of Idaho Falls, Idaho, in the southeastern portion of the INL. The ANL-W administrative boundary covers approximately 1,200 acres (see Figure 4-54). All facilities within ANL-W are currently active with the exception of the EBR-II research reactor, which has been defueled and is undergoing deactivation. There are three other research reactors that are either operating or are being maintained in a standby condition. There are also two large hot cell facilities within ANL-W that are dedicated to spent nuclear fuel reprocessing research, development, and demonstration. ANL-W has a fire station, a cafeteria, and a small medical dispensary. ANL-W facilities are administered by the DOE Chicago Operations Office until calendar year 2005, when the DOE Idaho will become the administrator. ANL-W will have a long-term mission as an NE research and development facility. The facilities at ANL-W will be major assets in implementing future nuclear energy missions.

Figure 4-54. Aerial view of Argonne National Laboratory-West.

Thirty-seven release sites were evaluated in the *Comprehensive RI/FS for Argonne National Laboratory-West Operable Unit 9-04 at the INEEL (Final)* (ANL-W 1997). The *Final Record of Decision, Argonne National Laboratory-West, Operable Unit 9-04* (ANL-W 1998) was signed on September 29, 1998. An *Explanation of Significant Difference for the Record of Decision for Argonne National Laboratory-West Operable Unit 9-04* (Davidson, Allred, and Wunderlich 2004) was approved in June 2004.

Eight areas were identified as having contamination that may present risk to human health or the environment. These eight areas included the Sanitary Sewage Lagoons (ANL-04), Industrial Waste Pond, Ditch A, Ditch B (all from ANL-01), Main Cooling Tower Blowdown Ditch (ANL-01A), Interceptor Canal-Canal and Interceptor Canal-Mound (subportions of ANL-09), and the Industrial Waste Lift Station

Discharge Ditch (ANL-35). The remaining 33 sites were determined to have acceptable risk to human health and the environment and, therefore, required no action.

The principal source of contamination at ANL-W is located in the ditches that transport both surface water run-off and industrial wastewater discharges on the ANL-W site. The industrial wastewater discharges contained minor concentrations of contaminants. These contaminants filtered into the fine soils of the ditch and pond bottoms over the last 40 years of operation. The maximum depths of the contaminants at each site vary slightly but generally are contained within the top 2 ft of soil. The contaminants include nonradioactive metals, such as chromium, mercury, selenium, zinc, and silver. These contaminants originated from historical use of industrial water-treatment chemicals and photographic process discharges. Contaminants in the soil mound and Industrial Waste Pond Sediments include cesium-137.

4.9.1 Current State

Phytoremediation was the selected remedial action for all of the sites. Phytoremediation utilizes plants to extract contaminants from the soil by way of normal uptake mechanisms of the plants. The plant vegetation is then harvested, sampled, and disposed of at an approved disposal facility. The plant matter that contained cesium-137 was disposed of at RWMC, and the plant matter that contained inorganics was disposed of in the CFA landfill. Sample results of the ANL-W sites showed the contaminants were predominantly in the upper foot of soils. Thus, most of the contaminants were already within the plant root zone, and no major movement of soil was necessary. A contingent alternative of excavation and disposal was identified in the event that phytoremediation does not adequately reduce risk to human health and environment.

Three release sites currently pose unacceptable risks to human health. These are the Industrial Waste Pond Sediments (ANL-01), the Interceptor Canal, and the Interceptor Canal excavated soil mound (ANL-09). The Industrial Waste Pond and Interceptor Canal excavated mound sites have shallow-depth cesium-137 contamination resulting from an inadvertent discharge of radioactive liquid waste from the ANL-W analytical laboratory in 1969.

Four sites in OU 9-04 underwent phytoremediation for 4 years (1999–2002) and now have reduced concentrations of contaminants. These sites are the Interceptor Canal—excavated soil mound (ANL-09), Industrial Waste Lift Station Discharge Ditch (ANL-35), Main Cooling Tower Blowdown Ditch (ANL-01A), and Ditch A (ANL-01). These four sites were sampled in 2003 to verify that the remediation goals in the ROD had been met. Sample results received in November of 2003 verified that remediation goals were met at ANL-01A and ANL-09. A portion of the Ditch A (ANL-01) site had residual mercury contamination above the remediation goal of 0.74 ppm, and a portion of ANL-35 had residual silver contamination above the remediation goal of 112 ppm. Both of these sites posed unacceptable risks to ecological receptors only. The contingent ROD remedy of excavation and disposal was implemented in the summer of 2004 for these two areas. The excavated soil was disposed of at the CFA landfill.

The OU 9-04 ROD (ANL-W 1998) addresses remedial actions for the following eight release sites within ANL-W. Current status of the eight areas requiring remediation is summarized in the following list:

- Industrial Waste Pond Sediments (ANL-01). The Industrial Waste Pond is an unlined, 3-acre evaporative pond fed by the Interceptor Canal and site drainage ditches. The pond was excavated in 1959 and was in use until 2002. When the ROD was signed in 1998, it was estimated that it would take 5 years to remediate the Industrial Waste Pond using phytoremediation. Phytoremediation was expected to begin after the Industrial Waste Pond was taken out of service, which was expected to

take place in the 2002–2003 timeframe. However, results of phytoremediation conducted at ANL-W over 4 years indicated that the contaminants are more resistant to phytoremediation than anticipated. In addition, a new project has been identified at ANL-W that may require use of the Industrial Waste Pond for disposal of clean cooling water in the 2006–2008 timeframe. Therefore, the contaminated soil was excavated and disposed of at the ICDF in 2004. Institutional controls are required because Industrial Waste Pond Sediments contain residual cesium-137 at levels that pose a risk to occupational receptors.

- Ditch A (ANL-01). Phytoremediation was conducted for 4 years, but a portion of the site had residual mercury contamination above the remediation goal of 0.74 ppm. The residual contamination was excavated and disposed of at the CFA landfill during the summer of 2004.

- Ditch B (ANL-01). Remediation was completed in 1999.

- Main Cooling Tower Blowdown Ditch (ANL-01A). Remediation was completed in 2003.

- Sewage Lagoon sediments (ANL-04). Three Sanitary Sewage Lagoons cover approximately 2 acres. The lagoons are still in use and will continue to be used for disposal of sanitary waste for approximately 30 more years. Between 1975 and 1981, photoprocessing solutions were discharged to the Sewage Lagoons. The site contains mercury contamination, which poses a risk to ecological receptors. Phytoremediation will take place after the ponds are taken out of service, currently anticipated for 2035.

- Interceptor Canal—canal portion (ANL-09). Cesium-137 activity posed an unacceptable risk to the occupational scenario only. Institutional controls are required to protect occupational receptors until cesium-137 decays to acceptable levels in 2087.

- Interceptor Canal—excavated soil mound (ANL-09). Phytoremediation was conducted for 4 years, and remediation goals have been met, but the site still poses risk to occupational receptors from residual cesium-137. Institutional controls are required to protect occupational receptors until the remaining cesium-137 levels decay to acceptable levels in 2099.

- Industrial Waste Lift Station Discharge Ditch (ANL-35). Phytoremediation was conducted for 4 years, but a portion of the site still contained residual silver contamination above the remediation goal of 112 ppm. The residual contamination was excavated in 2004.

A map showing the sites that require institutional controls at ANL-W is shown in Figure 4-55. A conceptual site model was developed as part of the *Comprehensive RI/FS for Argonne National Laboratory-West Operable Unit 9-04 at the INEEL (Final)* (ANL-W 1997). This model has been updated to reflect 2004 conditions and is shown in Figure 4-56. Additional details on contamination and risk levels at the contaminated sites are presented in Table 4-11.

4.9.2 End State

The ANL-W sites that pose an unacceptable risk to occupational receptors are the Interceptor Canal, the Interceptor Canal excavated soil mound, and the Industrial Waste Pond. The Interceptor Canal soil mound and the Interceptor Canal ditch will remain occupational health risk sites while the cesium-137 contamination decays to background levels by 2099 and 2087, respectively. The Industrial Waste Pond Sediments contain residual cesium-137 contamination that will decay to background levels by 2035.

A map of the end state is provided as Figure 4-57, and the conceptual site model for the end state is shown in Figure 4-58. The risk from these three sites will gradually diminish as the residual cesium-137 contaminants decay away. All three sites will pose no risk to residential scenario health by 2099 and will be released for unrestricted use. Institutional controls currently are in place at these sites and provide protection for human receptors. The institutional controls at the sites include postings to prevent access, access control for general public by location on the INL, and ANL-W procedure document precautions to be taken while working near these areas.

ANL-W Sewage Lagoons (ANL-04) will remain active at least until the 2035 timeframe. The lagoons have low concentrations of mercury in the sediments that pose a risk to ecological receptors only. The Sewage Lagoon sediments remain underwater thus eliminating the exposure pathway while in use. In approximately 2035, after final use of the Sewage Lagoons, the site will undergo additional sampling and characterization to determine the concentration of contaminants present so that the appropriate remediation technology can be determined.

4.9.3 Risk Assessment Summary

Detailed risk assessment information is provided in the *Comprehensive RI/FS for Argonne National Laboratory-West Operable Unit 9-04 at the INEEL (Final)* (ANL-W 1997).

4.9.3.1 Human Health Risk Assessment. The OU 9-04 comprehensive baseline risk assessment in the *Comprehensive RI/FS for Argonne National Laboratory-West Operable Unit 9-04 at the INEEL (Final)* (ANL-W 1997) includes an evaluation of human health risks associated with exposure to contaminants through soil ingestion, fugitive dust inhalation, volatile inhalation, external radiation exposure, groundwater ingestion, ingestion of homegrown produce, dermal adsorption of contaminants in groundwater, and inhalation of water vapors because of indoor water use. Adult exposures were evaluated for all scenarios and pathways; child exposures were considered separately only for the soil ingestion pathways in the residential scenarios.

The residential scenarios model a person living on the site 350 days a year for 30 years, beginning in 2097 (100 years from 1997). The 100-year residential scenario was selected for analysis because DOE control of INL lands is expected to last for at least 100 years. For purposes of the baseline risk assessment, the assumption was made that future residents will construct 10-ft basements beneath their homes, so the residents could be exposed to contaminants down to that depth.

Two occupational scenarios were evaluated as part of the baseline risk assessment for ANL-W. The assumptions used in the baseline risk assessment include nonintrusive daily industrial use without restrictions for 250 days/year for 25 days. Two time periods were evaluated as starting in 1997 and lasting 25 years and starting in 2027 and lasting 25 years.

Excess cancer risks below one in one million typically indicate that no further investigation or remediation is needed. Risks between one in 10,000 and 1 in 1,000,000 indicate that further investigation or remediation may be needed. Risks estimated above 1 in 10,000 typically indicate that further action is appropriate.

The baseline risk assessment indicated that for the current and future occupational scenario, only one contaminant (cesium-137) would pose an unacceptable risk to human health. Cesium-137 posed an unacceptable risk to both current and future occupational receptors and future residential receptors at two sites: the Industrial Waste Pond (ANL-01) and the Interceptor Canal-mound (ANL-09). The Interceptor Canal-canal (ANL-09) site poses an unacceptable risk only for current and future occupational receptors. These risks will be mitigated through standard operating procedures.

4.9.3.2 Ecological Risk Assessment. Wildlife species present in and around ANL-W include birds, mammals, and reptiles that are associated with facilities, sagebrush-steppe, rock outcroppings, deciduous tees and shrubs, grasslands, and water (e.g., Industrial Waste Pond and Sewage Lagoons). Both terrestrial and aquatic species are potentially present. Sagebrush communities surrounding ANL-W typically support a number of species including sage grouse, sage sparrow, and pronghorn. Rock outcroppings associated with these communities provide habitat for species such as bats and woodrats and for sensitive species such as the pygmy rabbit. Grasslands near ANL-W serve as habitat for species including the western meadowlark and mule deer. ANL-W also provides important wildlife habitat in the use of the buildings, lawns, ornamental vegetation, and ponds that are utilized by a number of species such as waterfowl, raptors, rabbits, and bats. No surface hydrology has existed to support fish**.** However, aquatic invertebrates are supported by habitat provided by the Sewage Lagoon and the Industrial Waste Pond while they are receiving wastewater from the facility there are no critical or sensitive habitats in the area near ANL-W. Six areas were determined to pose potentially unacceptable risks to the ecological receptors for five inorganics; chromium, mercury, selenium, silver, and zinc. These sites are the Industrial Waste Pond (ANL-01), Ditch A (ANL-01), Ditch B (ANL-01), Main Cooling Tower Blowdown Ditch (ANL-01A), Sewage Lagoons (ANL-04), and Industrial Waste Lift Station Discharge Ditch (ANL-35). Of these six areas, only the Industrial Waste Pond (ANL-01) also shows unacceptable human health risks.

Table 4-11. Contaminant concentrations and risk levels for sites under institutional control at Argonne National Laboratory-West.

Site Number	Contaminants of Concern	Residual Contamination (mg/kg or pCi/g)	Final Remediation Goal Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Receptors	Remediation Status	ICs for >100 Years	Basis for ICs and Comments
ANL-01 Industrial Waste Pond	Cesium-137	<23.3 pCi/g	23.3 pCi/g	8 in 10,000	4 in 10,000	1 in 10,000	Human health	Remediation complete	No	ICs are required to protect occupational receptors from exposure to cesium-137
ANL-01 Industrial Waste Pond	Chromium III	<500 mg/kg	500 mg/kg[a]	N/A	N/A	N/A	Ecological	Remediation complete	No	N/A
ANL-01 Industrial Waste Pond	Mercury	<0.74 mg/kg	0.74 mg/kg[a]	N/A	N/A	N/A	Ecological	Remediated in 2004	No	N/A
ANL-01 Industrial Waste Pond	Selenium	<3.4 mg/kg	3.4 mg/kg[a]	N/A	N/A	N/A	Ecological	Remediated in 2004	No	N/A
ANL-01 Industrial Waste Pond	Zinc	<2,200 mg/kg	2,200 mg/kg[a]	N/A	N/A	N/A	Ecological	Remediated in 2004	No	N/A
ANL-01 Ditch A	Mercury	<0.74 mg/kg	0.74 mg/kg[a]	NA	NA	N/A	Ecological	Hot spots remediated in 2004	No	N/A
ANL-01 Ditch B	Chromium III	<500 mg/kg	500 mg/kg[a]	N/A	N/A	NA	Ecological	Remediated in 1998	No	N/A
ANL-01 Ditch B	Zinc	<2,200 mg/kg	2,200 mg/kg[a]	N/A	N/A	N/A	Ecological	Remediated in 1998	No	N/A
ANL-01A Main Cooling Tower Blowdown Ditch	Chromium III	<500 mg/kg	500 mg/kg[a]	N/A	N/A	N/A	Ecological	Remediated in 2003	No	N/A
ANL-01A Main Cooling Tower Blowdown Ditch	Mercury	<0.74 mg/kg	0.74 mg/kg[a]	N/A	N/A	N/A	Ecological	Remediated in 2003	No	N/A

Table 4-11. (continued).

Site Number	Contaminants of Concern	Residual Contamination (mg/kg or pCi/g)	Final Remediation Goal Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Receptors	Remediation Status	ICs for >100 Years	Basis for ICs and Comments
ANL-04 Sewage Lagoons	Mercury	3.2 mg/kg	0.74 mg/kg[a]	N/A	N/A	N/A	Ecological	To be remediated in 2035	No	Sediment will remain under water, thus preventing the exposure pathway to ecological receptors
ANL-09 Interceptor Canal-Mound	Cesium-137	<23.3 pCi/g	23.3 pCi/g	8 in 10,000	4 in 10,000	1 in 10,000	Human health	Active decay	No	Remediation goals have been met; however, ICs are required while cesium-137 decays to levels acceptable for unrestricted use
ANL-09 Interceptor Canal-Canal	Cesium-137	18 pCi/g	23.3 pCi/g	5 in 10,000	2 in 10,000	8 in 100,000	Human health	Active decay	No	Remediation goals have been met; however, ICs are required while cesium-137 decays to levels acceptable for unrestricted use
ANL-35 Industrial Lift Station Discharge Ditch	Silver	<112 mg/kg	112 mg/kg[a]	N/A	N/A	N/A	Ecological	Hot spots remediated in 2004	No	N/A

a. Backward calculated risk-based concentration at the 1-in-10,000 level for humans and ten times background for ecological receptors

IC = institutional control
N/A = not applicable

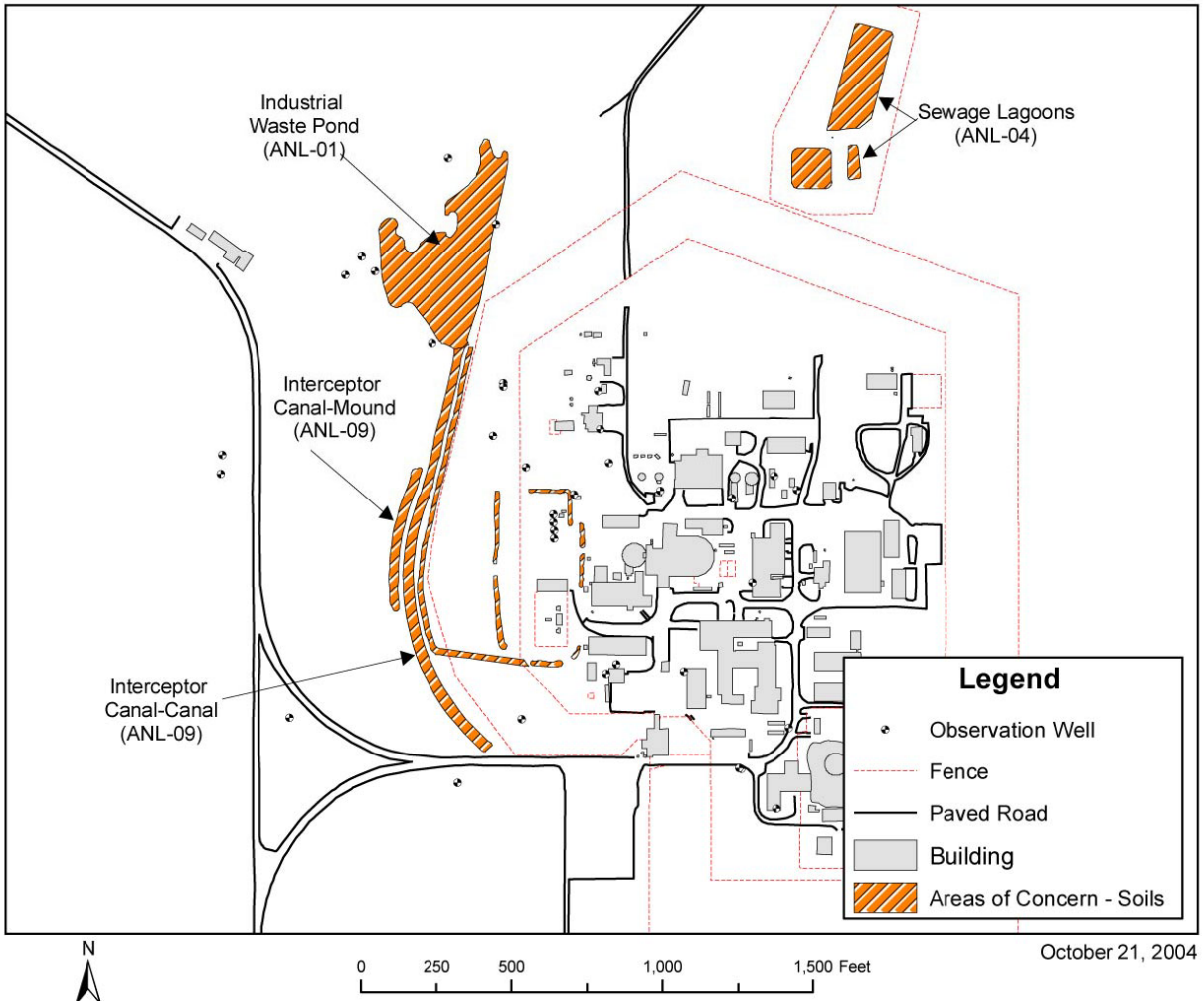


Figure 4-55. Argonne National Laboratory-West map—current state.

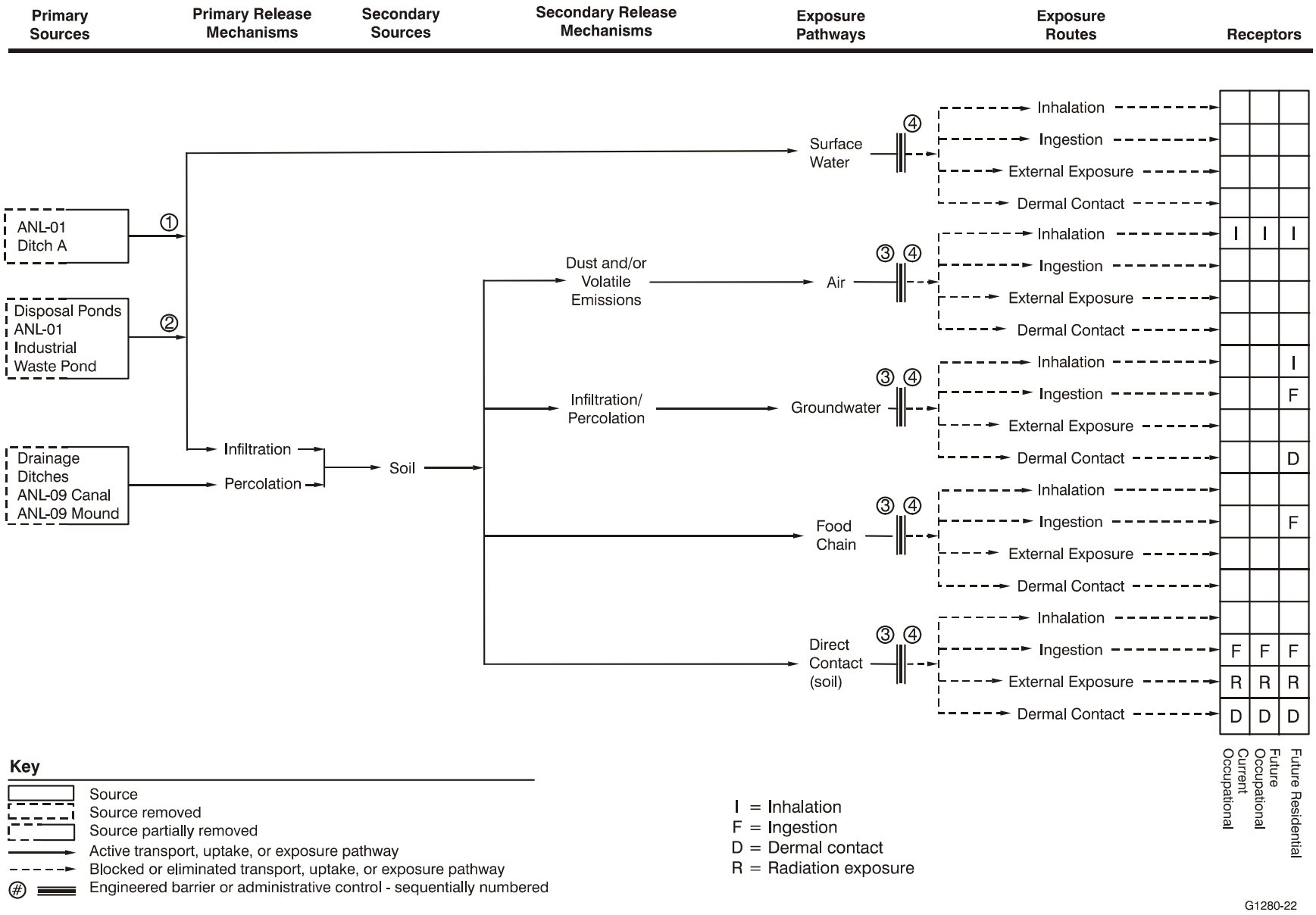


Figure 4-56. Argonne National Laboratory-West conceptual site model—current state.

Narrative for Figure 4-56 Argonne National Laboratory-West Conceptual Site Model—Current State

There are currently four areas where institutional controls are in place because residual contamination precludes unrestricted access. These areas include:

- One operating storm water and cooling tower water discharge pond (ANL-01 Industrial Waste Pond)
- One storm water drainage ditch (ANL-09 Interceptor Canal)
- One mound of soil dredged from the Interceptor Canal (ANL-09 Interceptor Canal mound)
- One drainage ditch with shallow-depth nonradioactive metal contamination in soil (ANL-01 Ditch A).

Actions and Barriers:

The steps taken to mitigate or remove these hazards are as follows:

1. The ANL-01 Ditch A underwent phytoremediation from 1999 to 2002. After phytoremediation, one contaminant, mercury, remained at levels slightly above remediation goals. The Ditch A soil with residual mercury contamination was excavated in Fiscal Year 2004, and the soil was disposed of in the ICDF. It is expected that institutional controls will be discontinued during the next 5-year review.

2. The selected remedy for the ANL-01 Industrial Waste Pond was extraction of the pond sediment contaminants by phytoremediation. This pond has been in use since 1960 to provide storm water and cooling tower drainage for the ANL-W site. There was an inadvertent discharge of radioactive liquids in the late 1960s, and the discharge of industrial cooling tower water was treated with toxic metal slimicides. The pond sediments are contaminated with cesium-137, chromium-3, selenium, mercury, and zinc. The Industrial Waste Pond was remediated in Fiscal Year 2004 by implementing the ROD contingent remedy of excavation and disposal of sediments that are contaminated to levels above remediation goals. The excavated soil was transported to the ICDF. Institutional controls are required until cesium-137 decays to acceptable levels for unrestricted use.

3. The ANL-09 Interceptor Canal has long-term institutional controls in place to protect workers from exposure to residual cesium-137 contamination until 2023. Workers are protected by posted signs and through the work control process.

   The ANL-09 Interceptor Canal mound soil was leveled and remediated to ROD remediation goals using phytoremediation from 1999 to 2002. Long-term institutional controls (i.e., posted signs, work controls, and site access controls) are in place to protect workers and the public from exposure to residual cesium-137 contamination. The remaining cesium contamination will decay to unrestricted-worker-use levels by 2053 and unrestricted residential-use levels by 2098.

4. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, and through the work control process used to identify hazards and mitigation measures for planned work activities. Precautions to be taken while working near these areas are documented in ANL-W procedures.

Failure Analysis:

Although failed controls are most likely to be found during the annual assessments, they may be discovered at any time. Subcontractors identifying a failed control will notify DOE Idaho. DOE Idaho will notify the EPA and DEQ within 2 business days after discovery of any major activity (e.g., unauthorized well drilling, intrusion into engineered covers, or change in land use from industrial to residential) inconsistent with the specific institutional controls for a site or of any change in the land use or land-use designation of a site addressed in the ROD and listed in the INL CFLUP (DOE-ID 1997a). Minor inconsistencies (e.g., signs down or missing) will be resolved as necessary. If minor inconsistencies are identified during the annual assessment, the issue and resolution will be documented in the reports.

If DOE Idaho believes that an emergency exists, DOE Idaho can respond to the emergency immediately before notifying EPA and DEQ and need not wait for any EPA or DEQ input to determine a plan of action. DOE Idaho will identify the root cause of the institutional control process failure, evaluate how to correct the process to avoid future problems, and implement these changes after consulting with EPA and DEQ. Table A-1 (see Appendix A) provides responses to failed control procedures that will be used during DOE Idaho control of the INL Site.

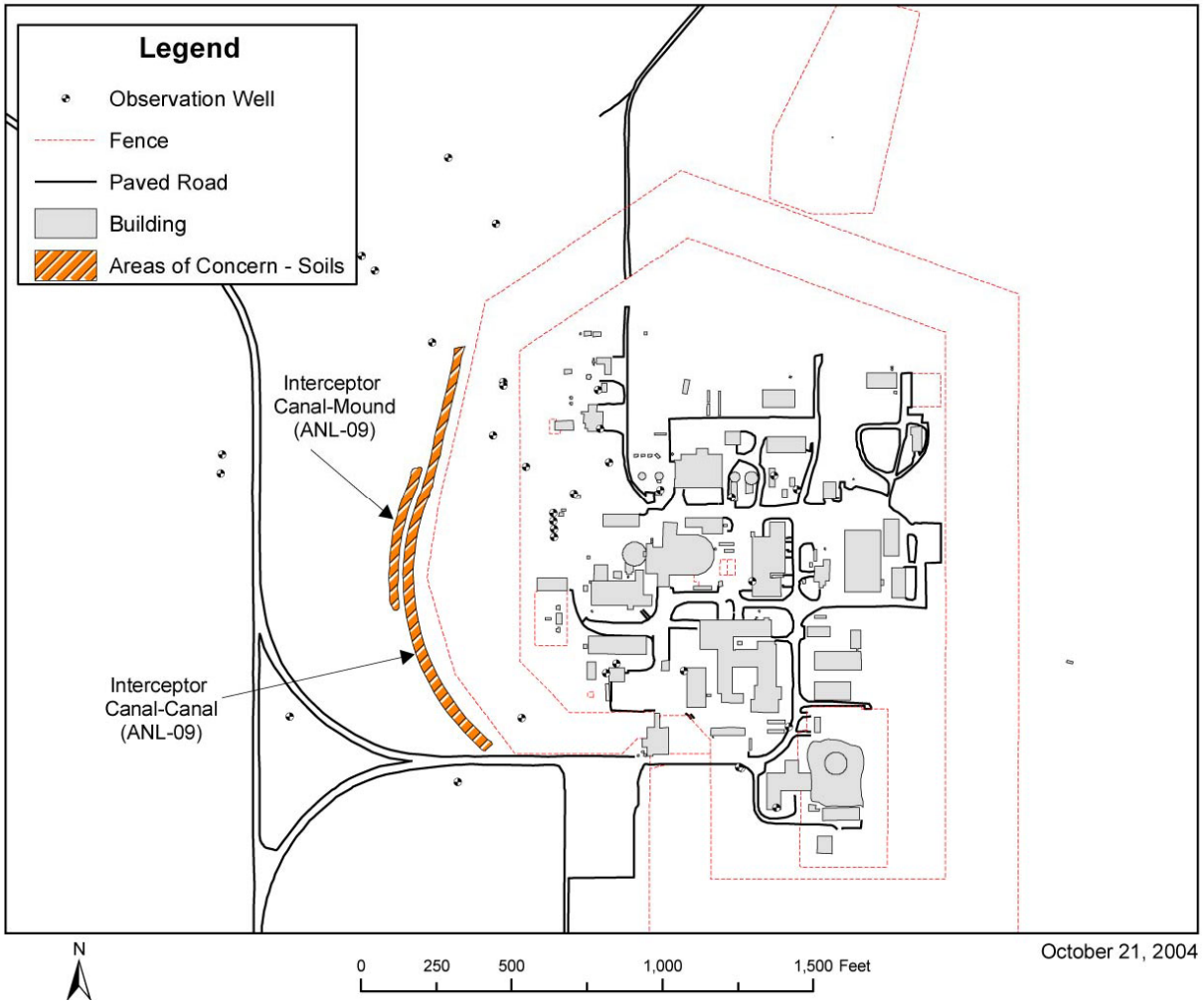


Figure 4-57. Argonne National Laboratory-West map—end state.

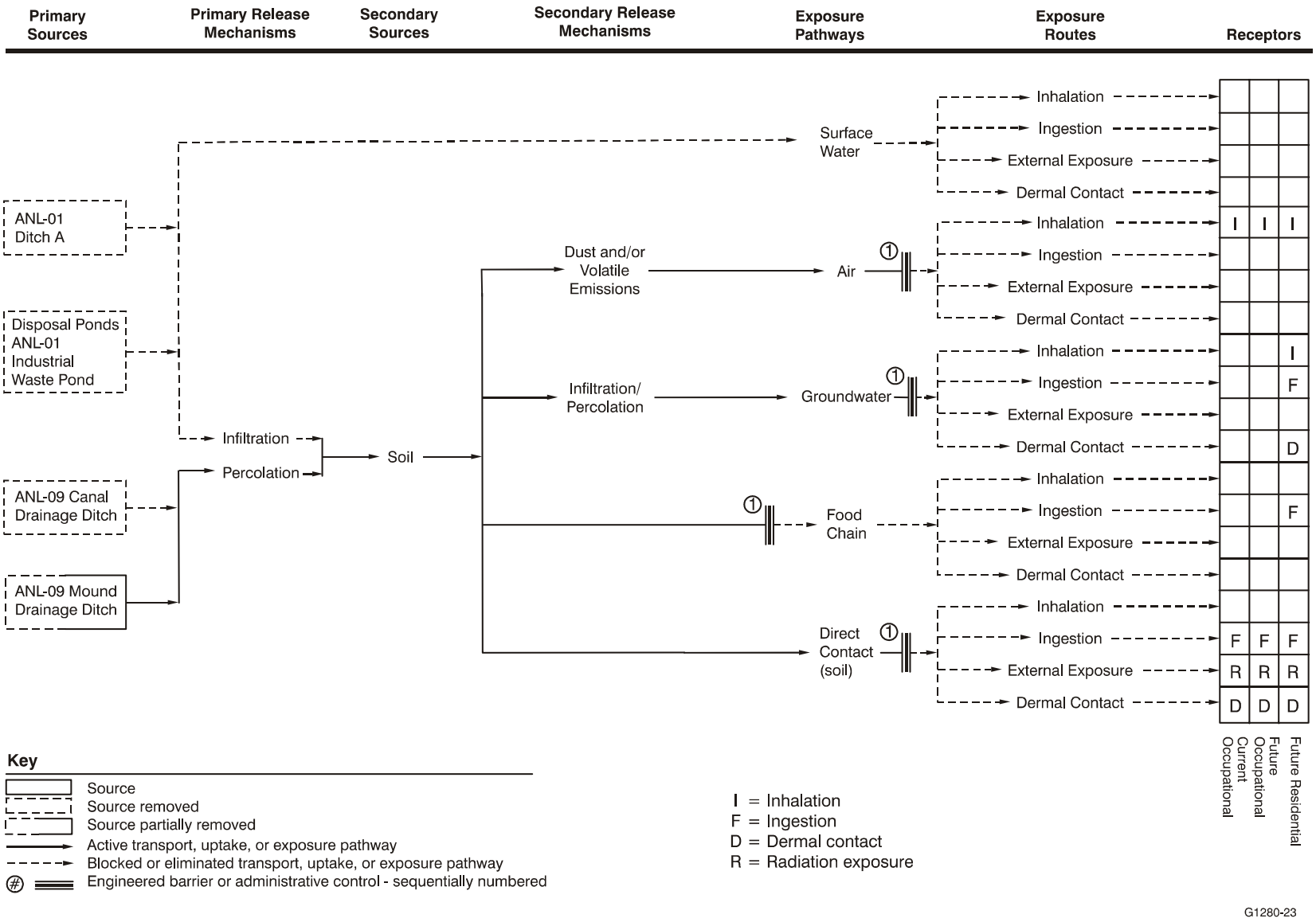


Figure 4-58. Argonne National Laboratory-West conceptual site model—end state.

Narrative for Figure 4-58 Argonne National Laboratory-West Conceptual Site Model—End State

It is anticipated that the following two sites at ANL-W will require institutional controls because of residual cesium-137 contamination:

- One storm water drainage ditch (ANL-09 Interceptor Canal)
- One mound of soil dredged from the Interceptor Canal (ANL-09 Interceptor Canal mound).

Actions and Barriers:

The steps taken to mitigate or remove these hazards are as follows:

1. Long-term institutional controls will be required at the ANL-09 Interceptor Canal mound site until 2098 to protect hypothetical residential receptors. The site will have restricted access to prevent intrusion by the public. Institutional controls to protect workers will be required until 2053. These controls include posted signs and work control processes that limit worker activities in this area. In the event that the DOE mission should end at some unknown time in the future, deed restrictions would be required to prevent intrusion into those areas with residual contamination.

Failure Analysis:

Although failed controls are most likely to be found during the annual assessments, they may be discovered at any time. Subcontractors identifying a failed control will notify DOE Idaho. DOE Idaho will notify the EPA and DEQ within 2 business days after discovery of any major activity (e.g., unauthorized well drilling, intrusion into engineered covers, or change in land use from industrial to residential) inconsistent with the specific institutional controls for a site or of any change in the land use or land-use designation of a site addressed in the ROD and listed in the INL CFLUP (DOE-ID 1997a). Minor inconsistencies (e.g., signs down or missing) will be resolved as necessary. If minor inconsistencies are identified during the annual assessment, the issue and resolution will be documented in the reports.

If DOE Idaho believes that an emergency exists, DOE Idaho can respond to the emergency immediately before notifying EPA and DEQ and need not wait for any EPA or DEQ input to determine a plan of action. DOE Idaho will identify the root cause of the institutional control process failure, evaluate how to correct the process to avoid future problems, and implement these changes after consulting with EPA and DEQ. Table A-1 (see Appendix A) provides responses to failed control procedures that will be used during DOE Idaho control of the INL Site.

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